Strategies for high mass dilepton physics in heavy ion reactions at the colliders

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Abstract

Heavy quarkonia states provide, via their leptonic decays, an essential tool to probe the earliest stage of heavy ion collisions and are considered as a crucial signature for diagnosing the nature of the quark gluon plasma [1,2]. The study of high mass dileptons is therefore one of the major physics goals of RHIC and the LHC heavy ion program. This new regime of beam energies brings however the challenge of extracting, for the first time, the quarkonia signals in the presence of a significant and highly complex combinatorial background which arises mostly from the semi-leptonic decay of open charm and open bottom. Consequently, the high mass dilepton spectra exhibit peculiar features and the well known techniques for background subtraction (i.e. the so-called like-sign technique and event-mixing technique) which work successfully for low mass resonances at low beam energies, cannot be applied in a straightforward way. The two main underlying reasons are : i) the presence of a strong and correlated dilepton continuum from B mesons decay and ii) the $B\bar{B}$ oscillation mechanism [3] which produces an important correlated component in the like-sign dilepton spectra. Based on simulations performed for Pb + Pb collisions at LHC we will present the characteristics of the dilepton spectra at high invariant mass. We will discuss the problems related to the subtraction of the combinatorial background and present strategies to extract the signal for the resonances as well as for the continuum. As illustrative examples, the three dilepton channels ($e^{\pm}$, $\mu^{\pm}$, $e\mu$) in the acceptance of the ALICE detector will be considered with special emphasis on the Υ region.

[1] T. Matsui and H. Satz, Phys. Lett. B 178 (1986) 416

[2] J.F. Gunion, R. Vogt, Nucl. Phys. B 492 (1997) 301

[3] Eur. Phys. J. C 3 (1998) 555